

13.4 EXERCISES

HOMEWORK KEY

○ = WORKED-OUT SOLUTIONS
on p. WS1 for Exs. 7, 23, and 37
★ = STANDARDIZED TEST PRACTICE
Exs. 2, 11, 30, 31, 37, and 38

4 PRACTICE AND APPLY

Assignment Guide

Answer Transparencies
available for all exercises

Basic:

Day 1: pp. 878–880
Exs. 1–7, 11–15, 20–23, 26, 35–38,
42–54 even

Average:

Day 1: pp. 878–880
Exs. 1, 2, 5–8, 11, 14–16, 22–31,
35–39, 42, 45, 48, 51, 54

Advanced:

Day 1: pp. 878–880
Exs. 1, 2, 8–11, 17–19, 23–40*, 43,
46, 49, 52, 55

Block:

pp. 878–880
Exs. 1, 2, 5–8, 11, 14–16, 22–31,
35–39, 42, 45, 48, 51, 54 (with 13.5)

Differentiated Instruction

See *Algebra 2 Best Practices Toolkit*
for suggestions on addressing the
needs of a diverse classroom.

Homework Check

For a quick check of student under-
standing of key concepts, go over the
following exercises:

Basic: 4, 14, 27, 35, 36

Average: 6, 16, 28, 35, 37

Advanced: 10, 18, 29, 36, 37

Extra Practice

- Student Edition, p. 1022
- Chapter 13 Resource Book:
Practice levels A, B, C, pp. 39–41

Practice Worksheet

An easily-readable reduced
practice page (with answers)
for this lesson can be found
on p. 850C.

SKILL PRACTICE

A 1. **VOCABULARY** Copy and complete: The $\frac{1}{2}$ sine of $\frac{\pi}{6}$ is $\frac{\pi}{6}$, or 30° . **inverse**

2. **★ WRITING** Explain why $\tan^{-1} 3$ is defined, but $\cos^{-1} 3$ is undefined. **Sample answer:** The range of $\tan \theta$ is all real numbers but the range for $\cos \theta$ is $-1 \leq \cos \theta \leq 1$ and 3 is not in the range.

EVALUATING EXPRESSIONS Evaluate the expression without using a calculator.

Give your answer in both radians and degrees.

3. $\sin^{-1} 1$ $\frac{\pi}{2}, 90^\circ$ 4. $\tan^{-1} (-1)$ $-\frac{\pi}{4}, -45^\circ$ 5. $\cos^{-1} 0$ $\frac{\pi}{2}, 90^\circ$ 6. $\cos^{-1} (-2)$ **undefined**

7. $\sin^{-1} \frac{\sqrt{3}}{2}$ $\frac{\pi}{3}, 60^\circ$ 8. $\sin^{-1} \frac{1}{2}$ $\frac{\pi}{6}, 30^\circ$ 9. $\tan^{-1} \left(-\frac{\sqrt{3}}{3} \right)$ $-\frac{\pi}{6}, -30^\circ$ 10. $\cos^{-1} \left(-\frac{1}{2} \right)$ $\frac{2\pi}{3}, 120^\circ$

11. **★ MULTIPLE CHOICE** What is the value of the expression $\cos^{-1} \frac{\sqrt{2}}{2}$? **C**

- (A) 0° (B) 30° (C) 45° (D) 60°

USING A CALCULATOR Use a calculator to evaluate the expression in both radians and degrees.

12. $\sin^{-1} 0.18$ **about 0.18, about 10.4°** 13. $\tan^{-1} 2.6$ **about 1.20, about 69.0°** 14. $\cos^{-1} 0.36$ **about 1.20, about 68.9°** 15. $\cos^{-1} (-0.4)$ **about 1.98, about 113.6°**
16. $\tan^{-1} (-0.75)$ **about -1.1, about -11.5°** 17. $\sin^{-1} (-0.2)$ **about -0.20, about -11.5°** 18. $\sin^{-1} 0.8$ **about 0.93, about 53.1°** 19. $\cos^{-1} 0.99$ **about 0.14, about 8.1°**

16. **about -0.64 ,
about -36.9°**

17. **about -0.20 ,
about -11.5°**

EXAMPLE 2 B
on p. 876
for Exs. 20–26

SOLVING EQUATIONS Solve the equation for θ .

20. $\cos \theta = -0.82$; $180^\circ < \theta < 270^\circ$ **about 214.9°** 21. $\sin \theta = -0.45$; $180^\circ < \theta < 270^\circ$ **about 206.7°**
22. $\sin \theta = 0.15$; $90^\circ < \theta < 180^\circ$ **about 171.4°** 23. $\tan \theta = 3.2$; $180^\circ < \theta < 270^\circ$ **about 252.6°**
24. $\tan \theta = -5.3$; $90^\circ < \theta < 180^\circ$ **about 100.7°** 25. $\cos \theta = 0.25$; $270^\circ < \theta < 360^\circ$ **about 284.5°**

26. **ERROR ANALYSIS** Describe and correct the error in solving the equation $\sin \theta = 0.7$ where $90^\circ < \theta < 180^\circ$. **The domain restriction is $90^\circ < \theta < 180^\circ$ and 44.4° is not in the domain; 135.6° .**

The angle whose sine is 0.7 is
 $\sin^{-1} 0.7 \approx 44.4^\circ$, so $\theta \approx 44.4^\circ$.



EXAMPLE 3
on p. 877
for Exs. 27–29

FINDING ANGLES Find the measure of the angle θ .

27. **about 38.7°** 28. **about 80.5°** 29. **120°**

30. **★ OPEN-ENDED MATH** Suppose $\cos \theta > 0$ and $\sin \theta < 0$. Give a possible value of θ such that $-360^\circ \leq \theta \leq 0^\circ$. **Sample answer: -45°**

31. **★ OPEN-ENDED MATH** Suppose $\sin \theta < 0$ and $\tan \theta > 0$. Give a possible value of θ such that $360^\circ \leq \theta \leq 720^\circ$. **Sample answer: 600°**

C **CHALLENGE** Rewrite the expression so that it does not involve trigonometric functions or inverse trigonometric functions.

32. $\csc (\sin^{-1} x)$ x^{-1} 33. $\cot (\tan^{-1} x)$ x^{-1} 34. $\sec (\cos^{-1} x)$ x^{-1}

PROBLEM SOLVING

EXAMPLE 4 **A**
on p. 877
for Exs. 35–37

37. About 32.9° ; about 46.4 ft.
Sample answer: The pile is 15 feet high and the angle of repose is about 32.9° , the base of the right triangle formed is about 23.4 feet. Since this represents the radius of the pile, you need to multiply by 2 to get the diameter.

B

- 35. LADDER ANGLE** A fire truck has a 100 foot ladder whose base is 10 feet above the ground. A firefighter extends a ladder toward a burning building to reach a window 90 feet above the ground. Draw a diagram to represent this situation. At what angle should the firefighter set the ladder? **See margin for art; about 53°**

@HomeTutor for problem solving help at classzone.com

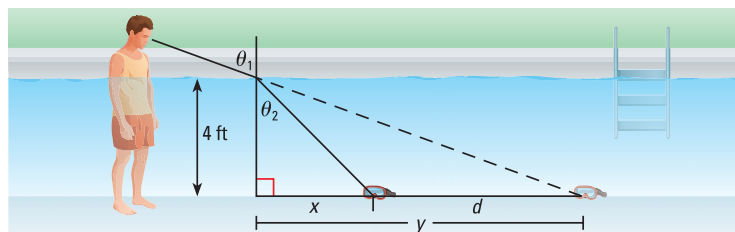
- 36. ANGLE OF DESCENT** An airplane is flying at an altitude of 31,000 feet when it begins its descent for landing. If the runway is 104 miles away, at what angle does the airplane descend? **about 3.23°**

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- 37. ★ SHORT RESPONSE** Different types of granular substances naturally settle at different angles when stored in cone-shaped piles. The angle θ is called the *angle of repose*. When rock salt is stored in a cone-shaped pile 11 feet high, the diameter of the pile's base is about 34 feet. Find the angle of repose for rock salt. If another pile of rock salt is 15 feet high, what is the diameter of its base? *Explain.*



- 38. ★ EXTENDED RESPONSE** If you are in shallow water and look at an object below the surface of the water, the object will look farther away from you than it really is. This is because when light rays pass between air and water, the water *refracts*, or bends, the light rays. The *index of refraction* for water is 1.333. This is the ratio of the sine of θ_1 to the sine of θ_2 for the angles θ_1 and θ_2 shown below.



- You are in 4 feet of water in the shallow end of a pool. You look down at some goggles at angle $\theta_1 = 70^\circ$ (measured from a line perpendicular to the surface of the water). Find θ_2 . **about 44.8°**
 - Find the distances x and y . **about 3.97 ft, about 11.0 ft**
 - Find the distance d between where the goggles are and where they appear to be. **about 7.03 ft**
 - Explain* what happens to d as you move closer to the goggles. **The distance decreases.**
- 39. CYCLING** As a spectator at a cycling road race, you are sitting 100 feet from the center of a straightaway. A cyclist traveling 30 miles per hour passes in front of you. At what angle do you have to turn your head to see the cyclist t seconds later? Assume the cyclist is still on the straightaway and is traveling at a constant speed. (*Hint:* First convert 30 miles per hour to a speed v in feet per second. The expression vt represents the distance, in feet, traveled by the cyclist.) **$\theta = \tan^{-1} \left(\frac{44t}{100} \right)$**



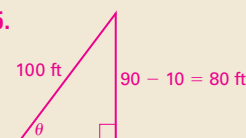
Graphing Calculator

Exercises 12–19 Show students how to evaluate these expressions directly in radian mode, which is more efficient than having to convert each angle from degree mode to radian mode.

Avoiding Common Errors

Exercises 20–25 When solving trigonometric equations with a calculator, a common error is to have the calculator set in the wrong mode. Make sure that all students know how to switch between degree and radian mode and tell them to get in the habit of checking which mode their calculator is in each time they start to use it in this chapter. As a quick check, if they are in the home screen, they can just enter $\sin(90)$. If the calculator returns 1, it is in degree mode; if not, it is in radian mode.

35.



5 ASSESS AND RETEACH

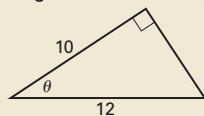
Daily Homework Quiz

Transparency Available

1. Evaluate $\sin^{-1}\left(-\frac{\sqrt{3}}{2}\right)$ in both radians and degrees. $-\frac{\pi}{3}$ or -60°

2. Solve the equation $\tan \theta = -2.5$ where $90^\circ < \theta < 180^\circ$. **111.8°**

3. What is the measure of the angle θ in the triangle shown?



33.6°

4. A ramp goes from the ground to the entrance to a building. If the height of the ramp is 27 inches and the horizontal distance is 58 inches, what is the angle of the ramp? **about 25°**



Online Quiz

Available at classzone.com

Diagnosis/Remediation

- Practice A, B, C in Chapter 13 Resource Book, pp. 39–41
- Study Guide in Chapter 13 Resource Book, pp. 42–43
- Practice Workbook, pp. 187–188
- @HomeTutor

Challenge

Additional challenge is available in the Chapter 13 Resource Book, p. 46.

Quiz

An easily-readable reduced copy of the quiz (with answers) on Lessons 13.3–13.4 from the Assessment Book can be found on p. 850E.

Quiz 1–4. See Additional Answers beginning on p. AA1.

- C** 40. **CHALLENGE** You want to photograph a painting with a camera mounted on a tripod. The painting is 3 feet tall, and the bottom of the painting is 1 foot above the camera lens, as shown. How far should the camera be positioned from the wall in order to have the largest possible viewing angle θ when you take the photograph? (Hint: Write an equation for θ in terms of x only, and then use a graphing calculator to find the value of x that maximizes θ .) **about 37°**



MIXED REVIEW

Solve the equation.

41. $x + 4 = -\frac{1}{4}x - \frac{3}{8}$ (p. 18) $-3\frac{1}{2}$ 42. $18x^2 + x - 5 = 0$ (p. 259) $\frac{1}{2}, -\frac{5}{9}$

44. $3x^2 - 30x - 9 = 0$ (p. 284) $5 \pm 2\sqrt{7}$ 45. $27x^3 - 64 = 0$ (p. 353) $1\frac{1}{3}$ 46. $\sqrt[3]{x+12} = 5$ (p. 452) **113**

47. $(6x - 11)^{5/2} = 243$ (p. 452) $3\frac{1}{3}$ 48. $8^{x-4} = 32^{3x-8}$ (p. 515) $2\frac{1}{3}$ 49. $10^{2x} - 6 = 12$ (p. 515) **about 0.628**

Solve the rational equation. Check for extraneous solutions. (p. 589)

50. $\frac{4}{x} = \frac{9}{x+5}$ **4** 51. $\frac{2}{x-6} = \frac{10}{x}$ $7\frac{1}{2}$ 52. $\frac{3}{2+x} = \frac{-9}{4x}$ $-\frac{6}{7}$

53. $\frac{5}{x+1} + 3 = \frac{-7}{x+1}$ **-5** 54. $\frac{1}{x+3} = \frac{x}{3x+16}$ **± 4** 55. $\frac{3x}{x-4} = 2 + \frac{12}{x-4}$ **no solution**

PREVIEW

Prepare for Lesson 13.5 in Exs. 50–55.

QUIZ for Lessons 13.3–13.4

Use the given point on the terminal side of an angle θ in standard position to evaluate the six trigonometric functions of θ . (p. 866) 1–4. See margin.

1. (6, -2) 2. (-7, 5) 3. (4, 8) 4. (-12, -3)

Evaluate the expression without using a calculator. (p. 866)

5. $\cos 150^\circ$ $-\frac{\sqrt{3}}{2}$ 6. $\tan \frac{8\pi}{3}$ $-\sqrt{3}$ 7. $\sin(-840^\circ)$ $-\frac{\sqrt{3}}{2}$ 8. $\sec\left(-\frac{15\pi}{4}\right)$ $\sqrt{2}$

Evaluate the expression without using a calculator. Give your answer in both radians and degrees. (p. 875)

9. $\cos^{-1}\left(-\frac{\sqrt{2}}{2}\right)$ $\frac{3\pi}{4}, 135^\circ$ 10. $\sin^{-1}(-1)$ $-\frac{\pi}{2}, -90^\circ$ 11. $\tan^{-1}\frac{\sqrt{3}}{3}$ $\frac{\pi}{6}, 30^\circ$ 12. $\cos^{-1}\frac{1}{2}$ $\frac{\pi}{3}, 60^\circ$

Solve the equation for θ . (p. 875)

13. $\sin \theta = 0.3$; $90^\circ < \theta < 180^\circ$ **about 162.5°** 14. $\tan \theta = 6$; $180^\circ < \theta < 270^\circ$ **about 260.5°**
15. $\cos \theta = -0.72$; $90^\circ < \theta < 180^\circ$ **about 136.1°** 16. $\sin \theta = -0.55$; $270^\circ < \theta < 360^\circ$ **about 326.6°**

17. **ACROBATICS** A stuntman uses a 30 foot rope to swing 136° between two platforms of equal height, grazing the ground in the middle of the swing. If the rope stays taut throughout the swing, how far above the ground was the stuntman at the beginning and the end of the swing? How far apart are the two platforms? (p. 875) **about 18.8 ft; about 55.6 ft**

